Germano & ASSOCIATES, INC.

M E M O R A N D U M

to: Bruce Duncan

from: Joe Germano

re: Clarification on image interpretation

date: May 22, 2007

Hi Bruce,

Attached please find the spreadsheet you sent along with the information you requested; the only place where we disagreed on pile assignment (which I've highlighted) was for Station 71. Again, the key to assigning station locations to piles is the 2-D bathymetry results; look for the direction of the distortion vector of the normal bathymetric contour line, and you can tell from which pile center (A or X) they are emanating to assign location residues to one pile or another.

There are a few items which you mentioned on the phone that I also wanted to clarify; I'm not sure if I understood you correctly about your plan to look at individual images and assign a percentage of the area of that station to either a "recovery" or "non-recovery" status. If that is what you're planning on doing, then I would have to disagree with the approach, because it would violate the whole concept of replicate subsampling of a population, and you would be counting individual replicates as valid surrogates for populations measures (in other words, committing the sin of pseudoreplication à la Hurlbert, 1984.). The whole purpose of taking 3 replicate images per station is to get an idea of within-station variance for the various parameters being measured and to allow a more accurate assessment of biological recovery. For example, if Stage 3 fauna are present but in low density, one would not expect to see evidence of them in every single profile image; however, it you see evidence of them in 1 image, then you know they are "in the area", and that type of community is representative of that particular area (the same reason PSAMP protocols require 5 replicate grabs at a location to get a good idea of what type of community exists at a location). So, don't get hung up on whether or not a particular successional stage is present or not in one replicate image, what's important is what's going on at that location as represented by the evidence in and measurements from all the replicates taken (both SPI and plan view).

My take on what's going on with the fish waste is not really % of bone present, but what's associated with the bone (excess organic matter) as far as having a deleterious impact on the benthos. Having inert bone matter present is not much different than having poorly sorted sediments with a wide range of grain sizes; if you're in an area with all bone and no fine sand or silt/clay, then it would be the same kind of thing as being in an area of all gravel/cobble (there would be no organic matter to feed on or a suitable matrix for burrowing, therefore one would

not find the faunal typical of a soft-bottom environment). Bone by itself is not a problem, it's whether or not there are excess organics (decaying tissue) associated with the bone that would cause a noticeable stress on the benthic community.

It is also very important to remember that the successional progression of soft-bottom infaunal community recovery depicted in Figure 6 in the report is not a linear progression that cannot be reversed. This figure is a representation of primary succession, when an azoic substratum where there is no pre-existing community is placed in the marine environment, and no further disturbances occur (Germano 1983). Once any community gets established in an area, there are deviations from this idealized representation, and constant ecosystem recovery is a part of the natural landscape. The recovery process is always occurring because of the frequency of natural disturbances on a wide variety of spatial and temporal scales (Thistle 1981; Sousa 1984; Hall 1994), and secondary succession, or re-establishment of communities in areas where residual fauna still exist, is the rule rather than the exception (Horn 1974; McIntosh 1980). If one monitors any area of seafloor, the results will show a patchwork-quilt pattern of bottom in different stages of successional recovery. In fact, the successional patterns will most likely be on a scale smaller (meters to tens of meters) than one might initially suspect (Rhoads and Germano 1982). As Johnson (1972) stated so aptly, most bottoms represent "relicts of former disasters." In fact, it is quite possible that there will never be a point the entire area of interest is covered by a Stage 3 infaunal assemblage because of localized or small scale disturbances (physical or biological) that will be constantly occurring. Therefore, what needs to be kept in mind when evaluating the potential for recovery is that "full recovery" in an area is really the **capacity** of any area to support a Stage III assemblage; one should not assume that once a Stage 3 community is established, it is there for eternity. For example, it is quite likely that if some of the stations in Figure 19 where all 3 images show Stage 3 or Stage 1 on 3 were sampled next year, some of them might show a Stage 1 or Stage 2 assemblage. This does not mean that they can no longer be considered "recovered", because just as reaching the endpoint of the continuum is not an immovable constant, similarly a temporary retrograde does not represent a permanent condition. Once the SOD is not at a level where only hypoxic-tolerant species can survive (*sensu* Diaz and Rosenberg 1995) and Stage 1 taxa have been established, then it's a safe bet that this area will have the capacity to support a Stage 3 community and one will develop there eventually.

I appreciated the chance to go over all the images you listed, because it gave me the opportunity to review our work again and think some more about the specifics of Udagak Bay. I still agree with the classifications assigned to various locations in Figure 23, and one again came to the same conclusion that I stated at the meeting we had just before I took off for Sitka: that there really isn't a problem or cause for concern in the area where Pile A existed. Yes, there is some bone material left on the seafloor, but the majority of it appears to have been removed, and what remains is certainly not having an adverse effect on the resident infauna re-establishing themselves. While I would certainly love the opportunity to go back to Dutch Harbor and continue monitoring work there in the future, I honestly cannot in good conscience recommend that as a necessary step to confirm what I believe is an obvious outcome.

If you have any additional questions or need more information, please do not hesitate to contact me.

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